A REVIEW ON FUZZY LOGIC AND MACHINE LEARNING INOUR DAY TODAY LIFE

Abstract

We introduce here how the fuzzy Logic is essential in our modern life. Daily human being find different challenges which can not completely answer with Yes or No. Those problems are deals with Fuzzy Logic. Here we are trying to bring different real life problems in Fuzzy sets and define membership functions suitable to that problems based on different rules.

Keywords: Fuzzy logic, rules based, membership functions, heat, speed.

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I. INTRODUCTION

In everyday scenario, we might find ourselves in a situation whether a statement is true or false. Somewhere in the middle of true or false. The concept of "fuzzy" tells us about hazy character or something which is imprecise. Fuzzy logic in machine learning gives acceptable information in human understanding. In this chapter, we try to discuss the logic and its usefulness in machine learning in the following order:

Introduction to fuzzy logic Architecture of fuzzy logic Membership function a useful idea Comparisions of fuzzy logic with probability Application of fuzzy logic Usefulness and difficulties of fuzzy logic Fuzzy logic in machine learning : an example

II. INTRODUCTION TO FUZZY LOGIC

Fuzzy logic(FL) is a multi-valued logic in which truth value of variable takes any real values which is bounded above by 1 and bounded below by 0. Fuzzy logic technically does not take the boundary values. This technique is same as human function while taking decision. And it evaluates all middle values between "Yes" and "No".

1. Is it Raining?

In Boolean algebra truth value takes numerical value 1 if it is "Yes" and it takes 0 if it is "No". But in Fuzzy Logic it takes the partial too. Like if it is rainning heavily, then it can take numerical value say 0.987, a little rainning, then it can take numerical value say 0.24 and if it is drizling or rainning very less, then we can take the numerical value say 0.012.

The idea of fuzzy logic was seen by Lofti Zadeh in 1965 in his research paper "Fuzzy Set". Fuzzy logic is generally used for both commercial as well as practical purposes. It controls machines and consumer products. It may not provide accurate results. But It gives acceptable results. It helps dealing in uncertainty in Engineering.

III. ARCHITECURE OF FUZZY LOGIC

It consists of mainly four steps:

1 Fuzzification
2 Fuzzy rules base
3 Interference Method and
4 Defuzzi-fication.

- **Fuzzification:** It is the process of selecting crisp data into fuzzy data.
- **Fuzzy Rules Base:** It is a design task or a set of rules to control Fuzzy data.
- **Interference Method:** It is the process of reasoning where fuzzy logic is used to

make decisions. It involves fuzzification, rule evaluations, aggregation and defuzzification.

- **Defuzzi Fication:** It is the process of converting fuzzy data to crisp data.

1. **Membership Function a Useful Idea:** It is a mapping of curves which maps crisp value into membership value in the range of 0 to 1. It helps us to analyze a linguistic term to fuzzy sets in graph. A membership function for a fuzzy set F is defined as F: $Z \rightarrow [0,1]$ on the universe of discourse Z. It evaluates the degree of membership of the member in Z to the fuzzy set F. Graphically, x-axis denotes the universe of discourse and y-axis denotes the degree of membership in [0,1] interval. For a particular problem there may be multiple membership functions applicable to fuzzify a numerical value.

2. **Comparison of Fuzzy Logic with Probability :** Fuzzy logic analy- ses the notion of impreciseness while probability is associated with events rather than reality. Fuzzy logic analyses partial truth while probability deals with partial information. In fuzzy logic, truth degree is consider as mathematical basis while in probability, it is a mathematical model of uncertaintity.

3. **Application of Fuzzy Logic:** Fuzzy logic is used in various fields such as automotive system, domestic goods, environment control, etc. Some common applications are: It is used in aerospace field for altitude control of spacecrafts and satellites, it controls the speed and traffic in the automotive systems, it is used in decision making support system and personal evaluation in large company business, it also controls the pH, drying, chemical distillation process in the chemical industry.

4. **Usefulness and Difficulties of Fuzzy Logic:** It helps to control machines and control products. It helps to deal with uncertainty in engi- neering. The structure of fuzzy logic is easy to understand. It is widely used in practical and commercial purposes. It is mostly vigorous as no accurate input is required. in difficulties, fuzzy logic does not give always accurate result. So the answers are found based on assumptions and may not be useful in large domain. Setting rules, membership functions, finding fuzzy sets is a challenging work. At certain level fuzzy logic looks alike to probability theory. Validation and verification of fuzzy knowledge based system needs extensive testing with hardware.

IV. FUZZY LOGIC IN MACHINE LEARNING: AN EXAMPLE

The mechanism of fuzzy logic in any machine begins with a collection of membership functions for each set of fuzzy data we find a set of solution. Then we apply applicable principles in that membership functions to get a crisp out put data. Let us see with an example of processing data control and analyse fuzzy logic. Let us take "heat" is the input and "speed of fan" is the output.

1. **Step1:** Then we have to construct a set of membership functions for each input. Graphical representation of the fuzzy variable sets F will give the membership function. As an example we will use three fuzzy sets namely **hot,** warm and cold.

For each conditions we then define membership functions depending upon temperature.

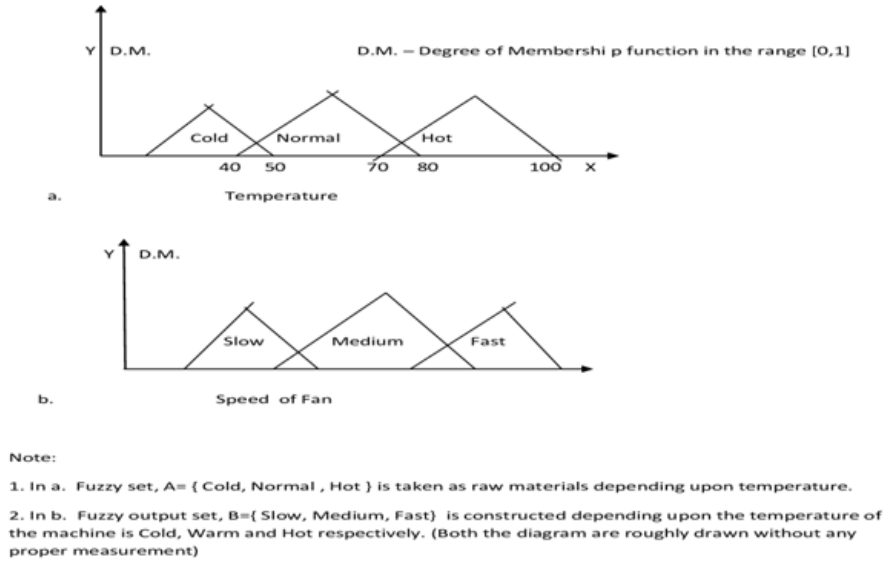

Figure 1:A.Input And B. Output

2. **Step2:** In step 2, we construct three fuzzy sets for the results namely fast, medium and slow. A set of membership function is then constructed for each result set as for the constructed set.

3. **Step3:** Then with the help of membership function we try to define rules to solve the systems. If cold then slow. If warm then medium If hot then fast. This principles is then apply to the membership functions to get the crisp out put value for the particular situation. Here we sometimes inter- sect the membership functions to get interesting point and then we can truncate the out put mappings at the peak of the interesting positions.

V. CONCLUSIONS

It is a simple example of how fuzzy logic works in a machine learning. In practical, there would be many intake data which gives different outputs. It will give acceptable results in a fairly manner. In our day today life we are fond of using machines. And many machines are runs on the principle of fuzzy logic. Washing machine, facial pattern recognition, air conditioners,vacuum cleaners, traffic control and lots of modern machines are runs on the principle of fuzzy logic. In our daily life a lots of problems which are partially considerable or degree of the problems are known. As for example suppose it is cloudy. Now the partial problem arises here that whether it will rain heavily or will drizle or no rain for that particular time. we can set conditional rules on that particular problem which will help to construct new membership functions and we can get acceptable solutions.

REFERENCES

[1] Aijun An., Jerzy Stefanowski, Sheela Ramanna, Cory J. Butz, and Witold Pedrycz Guoyin Wang (Eds.). *Rough Sets, Fuzzy Sets, Data Mining and Granular Computing*. 11th International Conference, RSFDGrC 2007 Toronto, Canada, May 14-16, 2007 Proceedings, 2007.
[2] Li Fanzhang et al. Dynamic fuzzy machine learning,. *Walter De Gruyter GmbH,*.
[3] Aboul Ella Hassanien, Abdel-Badeeh M. Salem, Rabie Ramadan, and Tai hoon Kim (Eds.). Advance machine learning technologies and applications. *First International Conference, AMLTA, Cairo, Egypt, Proceedings*, 2012.
[4] Hooda, D.S., and Vivek Raich. Fuzzy logic models and fuzzy control. *An Introduction, Alpha Science International*, 2016.
[5] J. Betty Jane and E.N.Ganesh. A review on big data with machine learning and fuzzy logic for better decision making. *INTERNATIONAL JOURNAL OF SCIENTIFIC TECHNOLOGY RESEARCH VOLUME*, 8, 2019.
[6] Nnamdi Uzoukwu. Machine learning with fuzzy logic. 2022.

